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Research Briefs

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Nutrition and Health

Senior citizens who get their vitamin A at the drug counter, rather than from fruits and vegetables, may be building up toxic levels. A recent study found that prolonged daily use of supplements containing retinyl esters—the pure form of A used in multivitamins—could lead to low-level toxicity. Although retinyl esters are not toxic themselves, once in the blood they can be converted into free retinol, which is toxic. In a survey of 562 men and women over 60, half reported taking supplements, mostly as multivitamin-multimineral preparations. Five participants who had taken the preparations daily for more than 5 years had retinyl ester levels two to three times normal. And four of the five had early signs of liver damage, a signal of chronic toxicity. Their daily dosage ranged from as little as the Recommended Dietary Allowance for vitamin A (5,000 i.u.) to four times the RDA. Younger people apparently don't have the same buildup of retinyl esters, the researchers found. This suggests that elderly Americans should get their vitamin A from fruits and vegetables rich in beta carotene—a nontoxic source. These include carrots, squash, tomatoes, dark-green leafy vegetables, peaches and apricots.

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Dietary iron may do more than prevent tired blood; it may also quell chattering teeth. A new study indicates that a person's ability to regulate or maintain body temperature in the cold may depend on his or her daily intake of iron. And these changes in metabolism occur before a person becomes anemic, or iron deficient. In the study, six healthy, young women consumed less than one-third the Recommended Dietary Allowance of iron, then replenished their iron stores with daily supplements. When exposed to a cool temperature, the women lost 29% more body heat and produced 9% less heat after the low-iron period than after the supplemental period. Because more than half of American women in the 11- to 50- year age group consume less than the recommended iron intake, impaired thermoregulation in cool and cold temperatures may be quite prevalent.

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... **And low copper or iron** could be the culprit if you're sleeping more and enjoying it less. The findings of five controlled studies on trace element nutrition are the first to link body stores of trace elements with sleep behavior. Women in the studies answered eight questions each morning about how long and how well they slept. Their responses were correlated with dietary intake and blood plasma levels of the element in question. Of seven elements studied, copper, iron and aluminum most strongly altered sleep patterns. Low copper intake prompted the most sleep problems followed by low iron intake. In both cases, sleep time increased and its quality decreased. The findings are from long-term intakes and don't mean that a copper or iron supplement will act as a sleeping pill. High doses of the nonessential element aluminum—common with regular use of antacids—decreased sleep quality only. The findings with calcium, magnesium, manganese and zinc were less conclusive and will be studied further.

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The old maxim, "You are what you eat," is proving truer than ever. It appears that dietary fat harbors more than extra calories; it also has a tendency to turn into body fat. In the first human study of its kind, 28 women consumed a high-fat diet (40% fat) for 4 months, then switched to a low-fat diet (20% fat) with the same number of calories for 4

more months. Carbohydrates replaced fat calories in the low-fat diet. The women's fat-to-lean ratio was assessed at the end of each period. After the low-fat period, they averaged 1% less body fat even though their weight remained constant. Although these findings are the first to confirm this effect in people, they agree with results of similar studies in animals. Cutting dietary fat helps to trim body fat in two ways—by reducing the tendency to deposit fat as well as by reducing calories—not to mention other health benefits.

Energy and Protein Nutrition Lab, Beltsville Human Nutrition Research Center, Beltsville, MD
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Older women can maintain healthy bones through endurance exercise despite the fact that the exercise makes them leaner and reduces circulating estrogen—two factors that normally increase risk of osteoporosis. A recent study compared 15 women between 55 and 70 years of age, who had been running at least 10 miles per week for 2 or more years, with 18 sedentary women of the same age range. The runners averaged 20 pounds lighter and 5% less body fat than the sedentary women even though they consumed more calories. And the runners had lower blood levels of estrone—the primary circulating form of estrogen in postmenopausal women. But bone density was the same for both groups, meaning the runners had greater bone mineral content for their weight. None of the runners began running until after menopause; and their level of exercise before menopause was about the same as the sedentary group's, indicating they didn't start with more bone mass.

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A high calcium intake plus whole grains at mealtime can actually subtract iron from the body. These and earlier findings indicate that taking a large calcium supplement at or close to a meal could reduce iron stores, particularly in many women who don't consume enough iron. Whole grains contain phytate—a constituent of bran that can bind to minerals in the intestine and carry them out in the stool. And animal studies have indicated that calcium enhances this phytate-mineral binding. While phytate levels in most American diets don't significantly reduce mineral absorption, will calcium supplements tip the balance? Nine men ate meals containing nearly twice the average intake of phytate together with three levels of calcium in food and supplements. Calcium levels of 600 and 1,100 milligrams did not increase iron or zinc in the stool. But 1,600 milligrams of calcium significantly increased stool iron levels and slightly increased stool zinc. The Recommended Dietary Allowance for calcium is 800 milligrams, but a consensus panel at the National Institutes of Health suggests an intake of 1,500 milligrams for postmenopausal women. Such a dose taken with high-fiber meals could reduce the bioavailability of iron.

Vitamin and Mineral Lab, Beltsville Human Nutrition Research Center, Beltsville, MD
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Vitamin C supplements may someday be prescribed for mild hypertension if recent findings hold up under more intensive research. An extra gram (1,000 mg) of vitamin C each day for 6 weeks significantly reduced blood sodium levels and sodium-to-potassium ratios in 12 men and women with mildly elevated blood pressure. These changes did not occur in eight men and women with normal blood pressure. Although the human body keeps a tight rein on blood sodium levels, they frequently run at the high end of normal in hypertensive people. The vitamin C supplements also lowered systolic pressure in the hypertensives but did not affect diastolic pressure—the one that concerns doctors most. ARS cooperated with researchers from Alcorn State University (Mississippi) in this carefully controlled study. The findings corroborate an earlier report indicating vitamin C might be effective against borderline hypertension.

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Diabetics—who have twice the rate of heart disease as nondiabetics—may not benefit from taking fish oil, which is being sold in capsules to help prevent heart disease. People with uncontrolled type II (mature-onset) diabetes have high blood triglyceride levels, which is also a risk factor for heart disease. In studies with nondiabetic animals and people, fish oil rapidly lowered blood triglycerides. Does it have the same effect on diabetics? Not when scientists tested it in an obese strain of rats that has all the symptoms of human type II diabetes. After 4 weeks on a diet containing menhaden oil (from the Atlantic herring), the rats' blood triglyceride, glucose and insulin levels were just as high as those who got corn oil instead.

Lipid Nutrition Lab, Beltsville Human Nutrition Research Center, Beltsville, MD
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Dietary fiber is touted as a preventive of heart disease, diabetes, obesity and possibly some forms of cancer. But it causes real headaches for chemists who have to measure it in foods. Now a simplified version of the method adopted by the Association of Official Analytical Chemists for determining dietary fiber gets rid of a lot of the fuss and muss but yields comparable results. Chemists will be able to analyze more samples with half the personal attention and at half the cost. The method could help speed up fiber information on foods if validated in further tests now being arranged by USDA's Human Nutrition Information Service, which publishes comprehensive food composition tables known as Agriculture Handbook 8. The simplified method also appears to be better than the official U.S. method for distinguishing between soluble and insoluble fiber—an important point since different types of fiber reportedly have different health benefits. HNIS will eventually list both fiber types in Handbook 8.

Nutrient Composition Lab, Beltsville Human Nutrition Research Center, Beltsville, MD
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Tomorrow's Foods

Salinas 88, a new iceberg lettuce, is expected on the market by 1989. ARS scientists developed the summer variety for California's Salinas Valley and adjacent Santa Maria Valley. Together these areas produce 80% of the nation's June-through-September lettuce harvest, worth an estimated \$400 million. Salinas 88 is resistant to lettuce mosaic virus, a costly disease that broke out recently in the Salinas Valley and infected one-third to one-half of the lettuce fields there.

Vegetable Production Research, Salinas, CA
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Soybeans and other legumes will provide a more complete source of protein when a corn gene for sulfur storage can be bio-engineered into the crops. Legumes are usually very low in sulfur-containing essential amino acids. As a start, scientists have inserted corn's sulfur-storage gene into tobacco cells and have grown back plants with high levels of sulfur and sulfur-containing substances. Legume varieties with high-sulfur amino acid can be developed only after scientists can regenerate seed-bearing soybeans and other plants from bioengineered cells. Meanwhile, the achievement with tobacco—as a model—helped scientists polish gene-inserting techniques.

Plant Molecular Genetics Lab, Beltsville, MD
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When it comes to flavor, U.S. peanuts fare better in world markets than those grown by three competing countries—China, Argentina and Malawi. That was the preliminary finding after the first year of a joint ARS/industry study. An agency flavor panel said U.S. peanuts had the highest intensity of roasted peanut and other positive flavors—and less bitterness and other off-flavors. Chemical analysis of the peanuts supported the panel's findings. Agency scientists and the U.S. peanut industry plan more studies over the next 2 years to confirm these findings—as part of an overall strategy to increase U.S. peanut exports.

Food Flavor Quality Research, Southern Regional Research Center, New Orleans, LA
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New products often come from old research. This year, for example, Heinz USA began selling partially defatted roasted peanuts nationwide under the Weight Watchers label. The process for making the peanuts is based on technology agency scientists developed more than 20 years ago. They found a chemical-free way to remove some of the fat from raw peanuts by using a press, which squeezes out about 50% of the oil. Raw peanuts don't crumble like roasted ones and regain their shape. After they are squeezed, the

peanuts are moistened with hot water before being roasted in oil for 5 minutes. Water steaming out of the peanut prevents oil from reentering. The result: a crunchy peanut with about 50% less fat than normal peanuts. Besides Heinz, Paul's Peanuts sells partially defatted peanuts based on this technology.

Food and Feed Processing Research, Southern Regional Research Center, New Orleans, LA
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Glasnost, or openness, should reap rewards for cooperating U.S. and Soviet scientists, but it spells trouble for hitchhiking insect pests. Scientists from the two countries conducted a joint study last winter confirming that phosphine gas, if properly circulated through wheat transported aboard ship, kills insects that may infest the grain. The study was done on 2.6 million bushels of U.S. wheat shipped from Galveston, TX, to the Soviet Union last December. As a result, the Soviets will use the procedure for U.S. wheat shipments of more than 40,000 tons and may use it for similar shipments of corn.

Stored-Product Insects Research and Development Lab
Savannah, GA
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Chinese chestnuts have about the same amounts of nutritious proteins as American chestnuts. That's good news for consumers as well as for American growers who are replacing American trees with Chinese species resistant to chestnut blight disease, which virtually wiped out chestnut trees in the eastern United States in the early 20th century. In a cooperative study, the first of its kind for chestnuts, ARS and USDA's Human Nutrition Information Service found no significant differences between the two chestnut species in essential amino acids, the main components of proteins.

Horticultural Crops Quality, Richard B. Russell Center
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In this age of biotechnology, does tissue culture mean better? Scientists say yes. They compared nutrient concentrations in apple leaves regenerated from lab-cultured cell tissue with leaves of the same varieties grown from buds grafted onto seedlings and root stock. Results from the 3-year study showed that the leaves of tissue-cultured trees contained more calcium. These trees also took up nutrients more efficiently. Further study is needed to see if more leaf calcium means more fruit calcium. Advantages of tissue culture include lower production costs, tree uniformity for easier management and shorter time to planting.

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Appalachian Fruit Research, Kearneysville, WV
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Food Freshness and Safety

Even though salt has been used since antiquity to preserve food, few studies have been done to identify how it inhibits bacteria from contaminating food. Now preliminary studies with *Escherichia coli*, a bacterium commonly found in the human intestinal tract, are shedding light on this phenomenon. Scientists found that salt, or sodium chloride, forces *E. coli* to waste energy as it rids itself of the toxic sodium ions. This means the bacterium has less energy to take in and use the nutrients it needs to grow to proportions that would cause illness. This provides new information for scientists and the food-processing industry in efforts to prevent contamination of foods.

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A fly leg in your soup: the restaurant-goer's worst fear. To help prevent that from happening, the Food and Drug Administration asked ARS to find out how far fly parts scatter when house flies are caught in electrocuting traps. To be safe, wall mounted traps should be 6 feet away from food areas, studies show, while ceiling-hung traps should be 10 feet away. These recommendations are safe even if there is a 5-mph breeze—such as that from a strong fan—blowing through the kitchen. The four major manufacturers of industrial restaurant fly traps, which cooperated by supplying them for the studies, can now use the data to recommend to restaurants which trap to buy and where to put it. In addition, state health inspectors can use the new FDA recommendation to make sure restaurants have traps a "healthy" distance from food.

*Livestock Insects Lab, Beltsville, MD
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Eliminating salmonella bacteria from fresh poultry is high on the priority list of both the poultry industry and government inspectors. Carcasses are now washed in poultry processing plants before they are chilled. But ARS scientists, using a special microscope, have found that salmonella bacteria are difficult to wash off poultry because these bacteria hide themselves in the ridges and crevices of the skin. To make things more difficult, these ridges become more pronounced when the carcass is immersed in water, sheltering the bacteria that much more. Washing the carcasses with salt water removed only a small percentage of the salmonella bacteria. Research is continuing, however, to find new ways to eliminate salmonella contamination of processed poultry.

*Poultry Meat Quality and Safety Research, Richard B.
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Mom was right when she said don't put tomatoes in the refrigerator, and now there's new evidence to prove it. A new procedure for measuring amounts of key flavor chemicals in tomatoes has shown that storing tomatoes in the refrigerator lowers the amount of a flavor component called (Z)-3-hexenal. With the help of taste panels, scientists had earlier identified this chemical as a key ingredient in fresh tomato aroma. But, until now, no one had been able to measure the exact amount of (Z)-3-hexenal or other flavor components because of chemical changes that occur when tomatoes are cut open. ARS researchers developed a better method to analyze precisely the amounts of natural chemicals that give fresh tomatoes their flavor. Breeders developing tastier tomatoes can use the test to evaluate the flavor components in new varieties.

*Food Quality Research, Western Regional Research Center
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The tropical neem tree that yields insecticidal chemicals also shows promise for controlling a major agricultural contaminant: aflatoxin. This toxin, produced by *Aspergillus flavus* and *A. parasiticus* fungi, can infect certain crops and make them unfit for consumption. Scientists found in lab studies that neem leaves, ground up or boiled in a solution, blocked more than 98% of the aflatoxin production by *A. parasiticus*. Scientists are planning greenhouse studies to see if the neem solution can be sprayed on crops to get the same result. If so, neem, long used in India and Africa as an insect repellant, toothpaste and soap, may become a new biocontrol for aflatoxin.

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Nutmeg and mace may one day be used not only as cooking spices, but as natural controls for insects that infest stored wheat and other cereal grains. In lab studies, oil extracts of these spices— from the fruit of the evergreen tree *Myristica fragrans*—killed 10% to 20% of two beetle pests and 30% to 40% of rice weevils at doses of 30 micrograms per insect. And the extracts, sprayed on wheat at concentrations of 2,000 parts per million, repelled rice weevils for up to 4 months. Natural controls such as these are needed as insects become more resistant to malathion and other synthetic chemicals.

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